



US LHC Accelerator Research Program

Brookhaven – fermilab - berkeley - stanford

BNL: Accelerator Physics and Beam Commissioning Status and Plans

Accelerator Physics

Collimation Studies

e-cloud

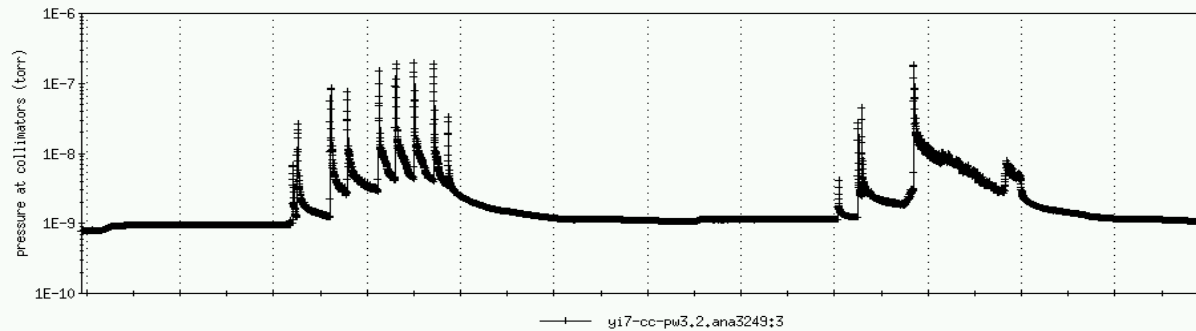
Beam commissioning

beam time at SPS

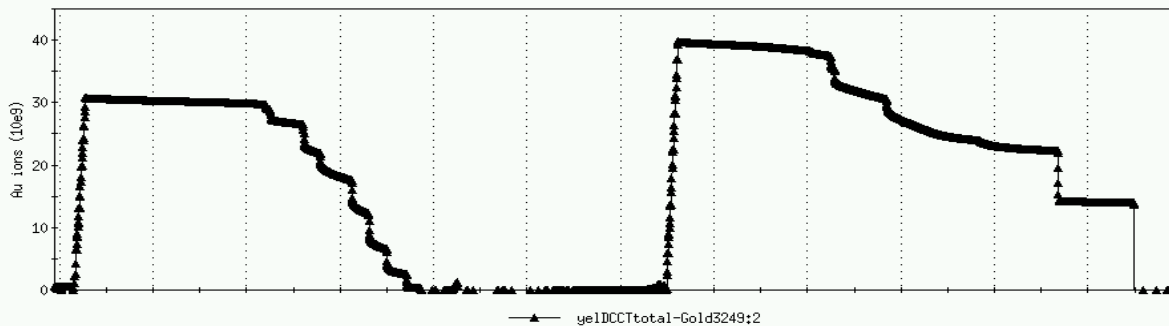
luminosity monitor commissioning (?)

Budget/FTEs FY05&06

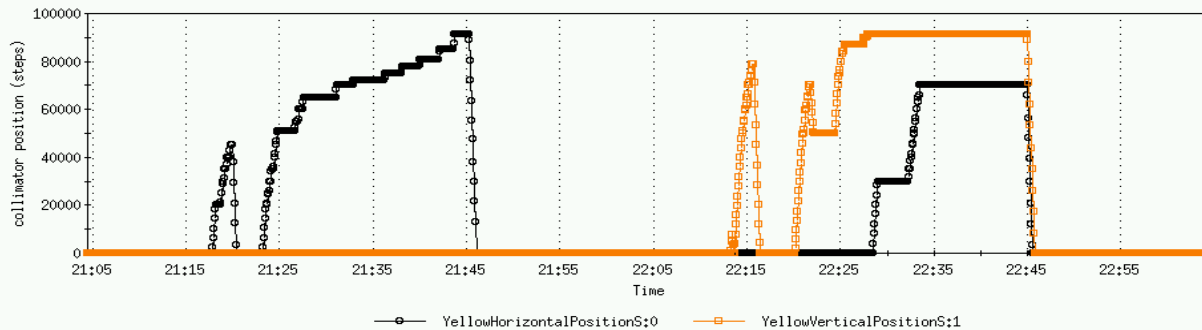
Collimation Studies



pressure at coll.



beam current

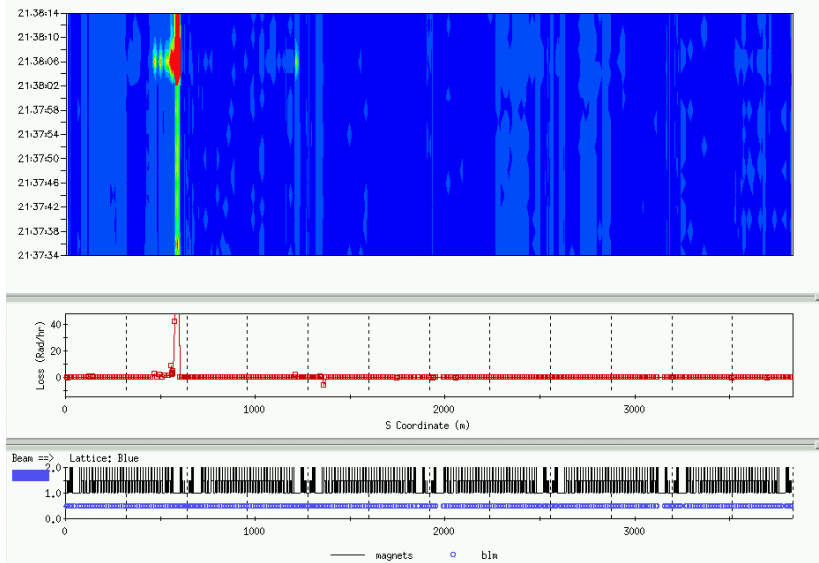


coll. pos.
horiz. & vert.

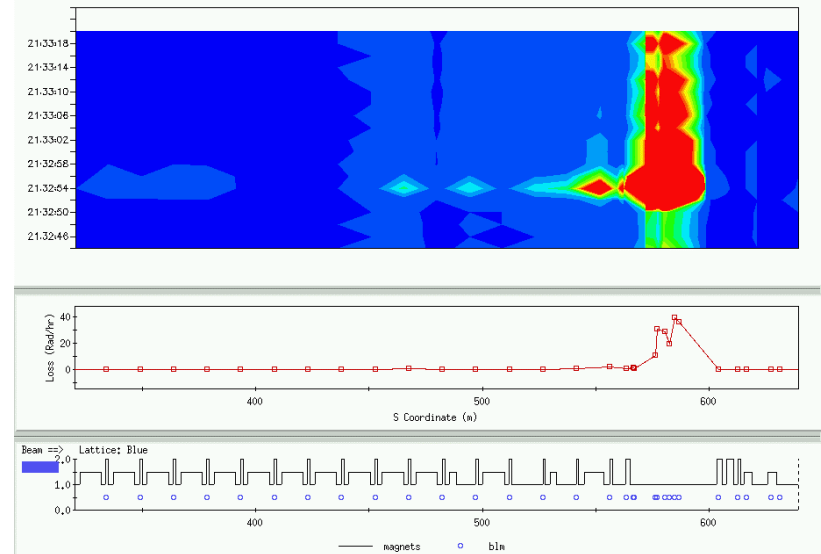
Beam is scraped away using collimators as scrapers. BLM data is recorded around the ring

Losses around the ring (Inj.)

Losses in the yellow ring (Au)



Zoom into collimator area

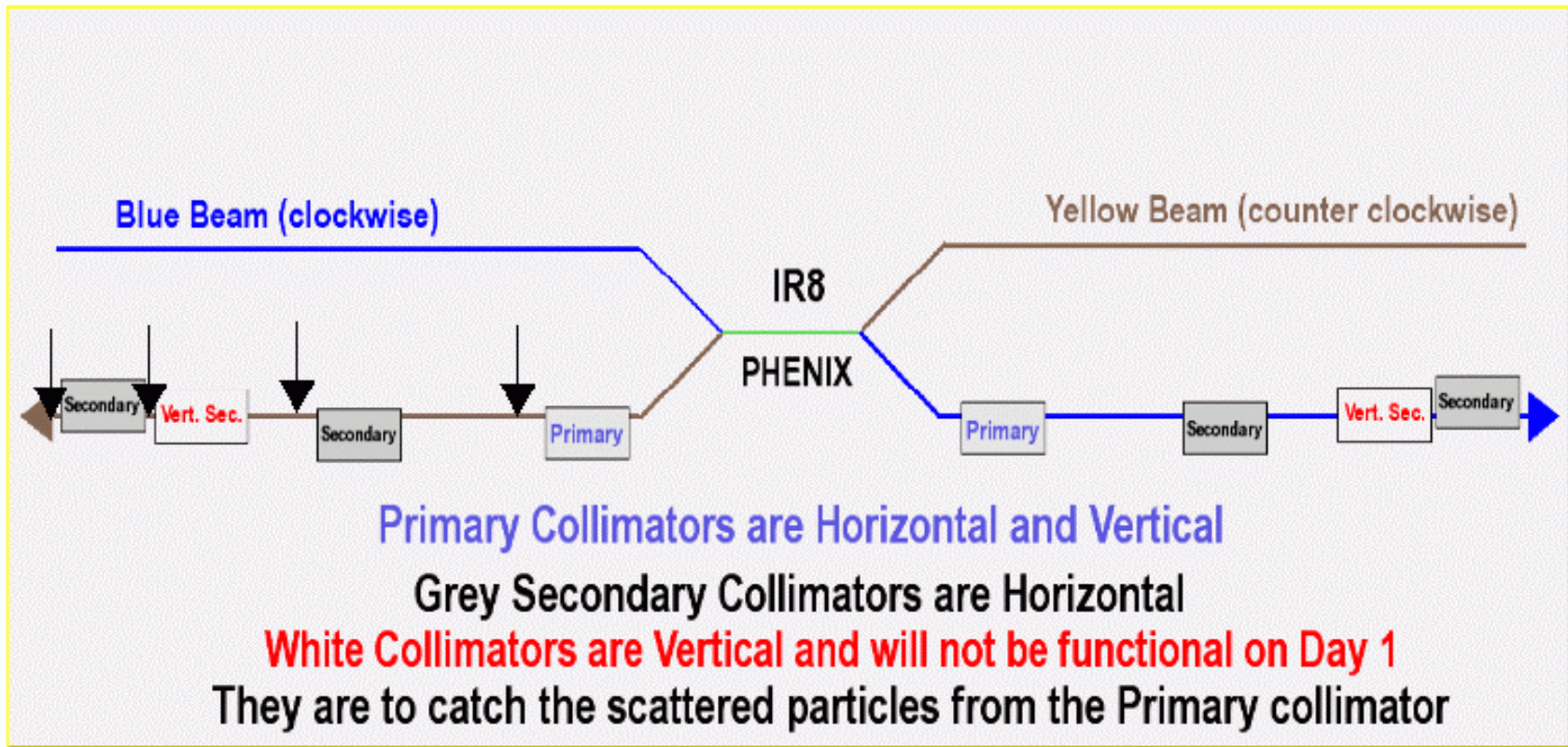


direction of beam

Data taken in a "beam experiment" shift to tune simulation software.

More data available at storage energy and various species (Au, d, p)

New Collimation System



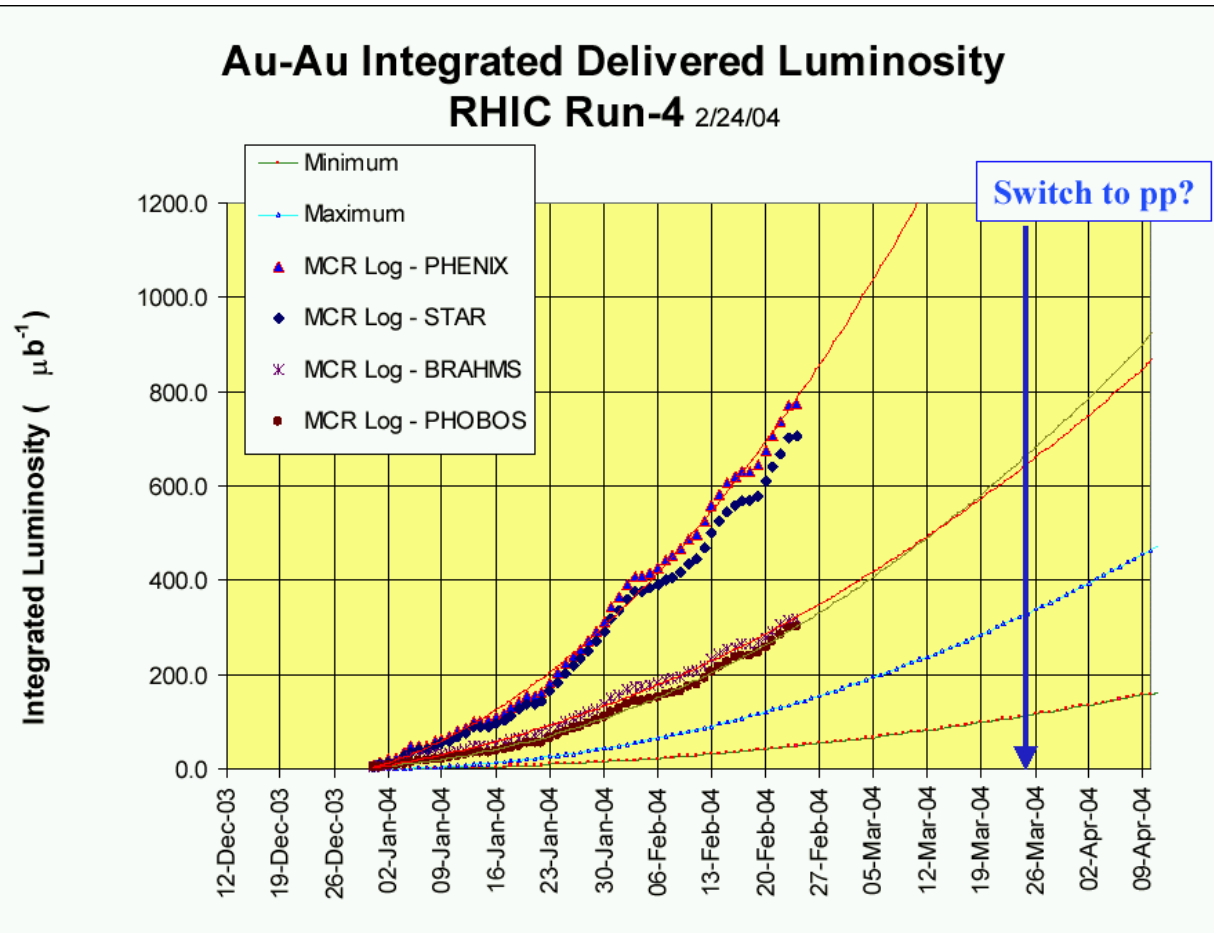
The positions in [m] from the IR are:

primary	41.2
1. secondary H	51.1
secondary V	57.3
2. secondary H	58.3

↓ position PD 1m downstream of collimator (or as much downstream as possible)

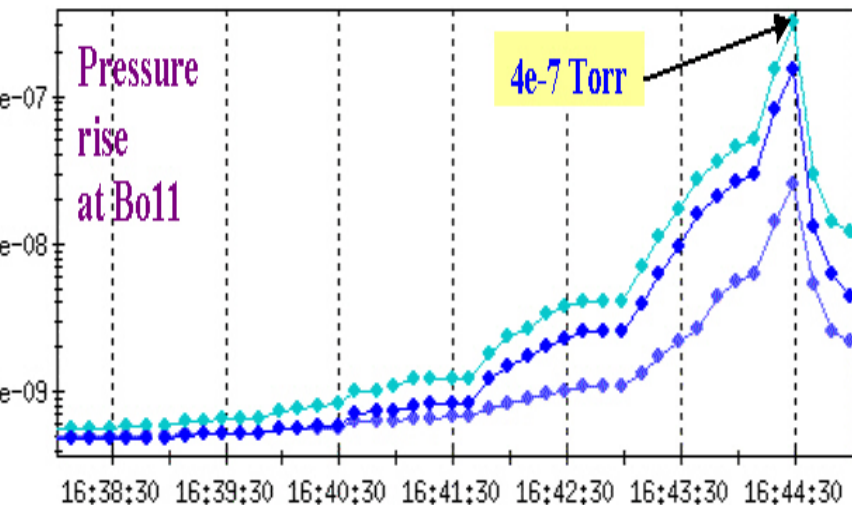
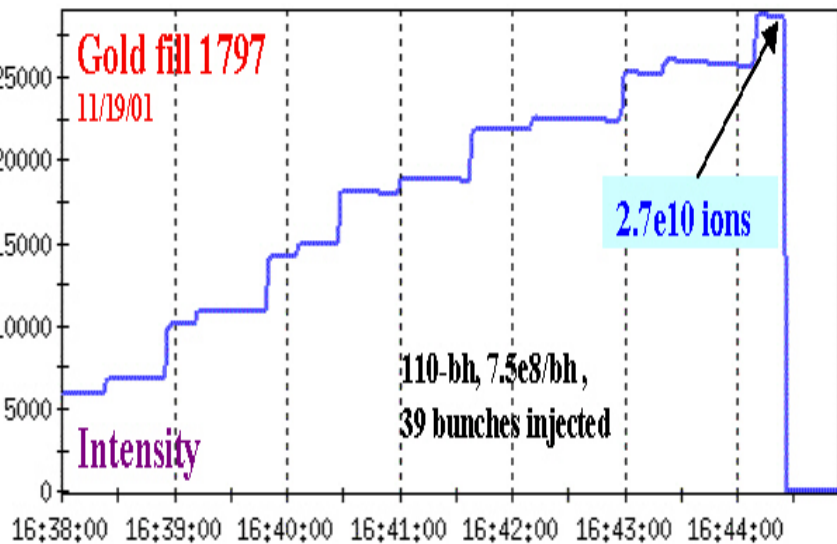
PHIC/LHC needs multiple collimator control on the ramp/during the store

Luminosity Limitation at RHIC: e-clouds!



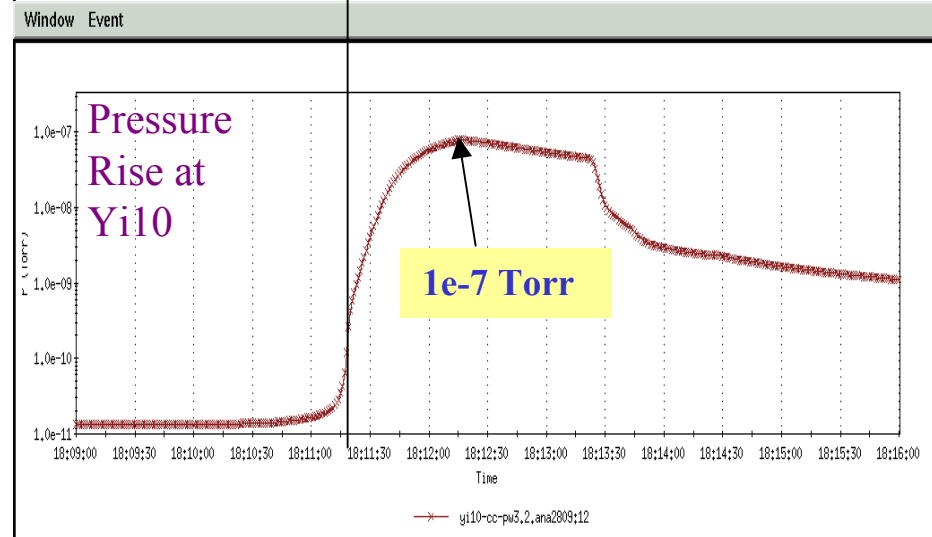
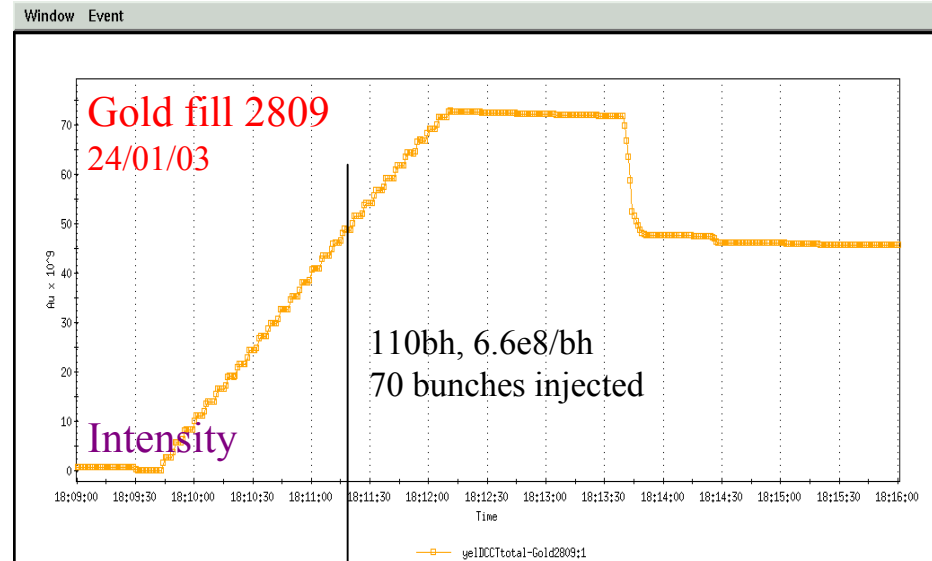
Vacuum and pressure rises are THE current luminosity limitation
at RHIC

2001/2002



55/110 bunches;
Au limit: $4 \cdot 10^8$ Au⁺/bunch
p limit: $1 \cdot 10^{10}$ p/bunch

2002/2003

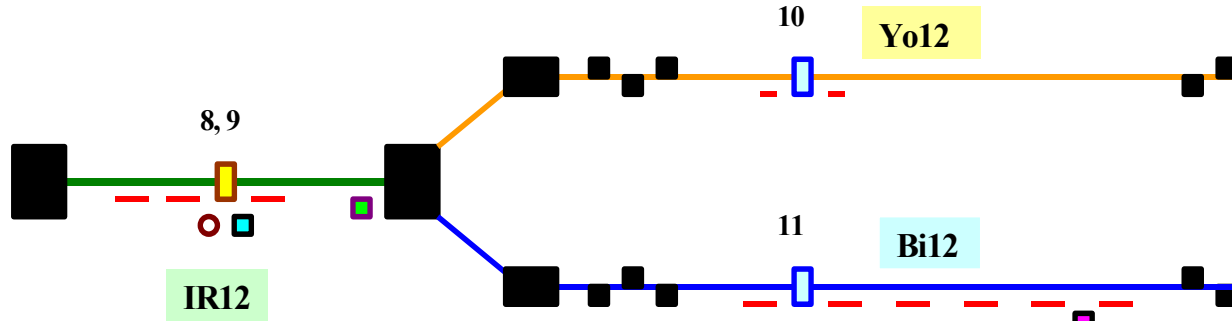
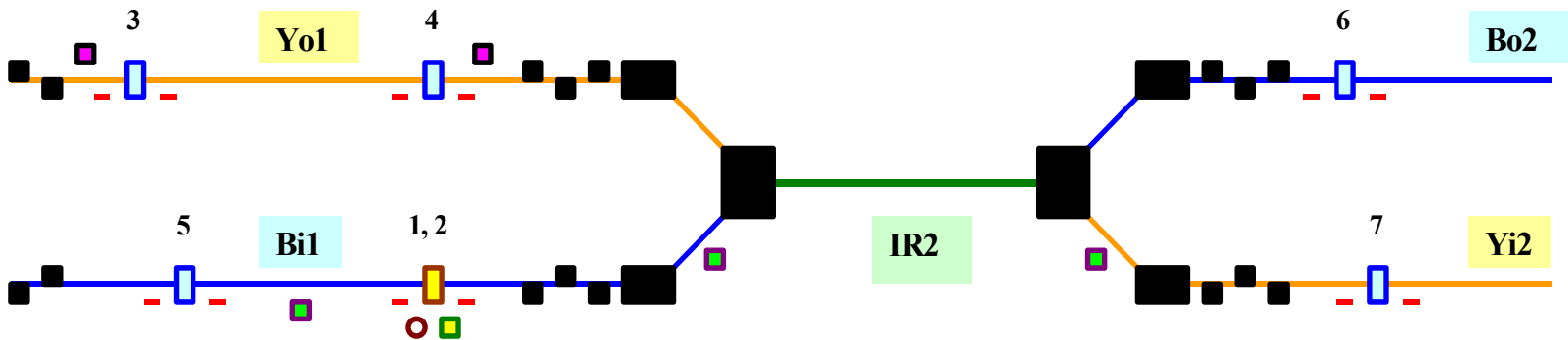


110 bunches;
Au limit: $6.5 \cdot 10^8$ Au⁺/bunch
d limit: $>5 \cdot 10^{10}$ d/bunch

*But no ED
In Yi10...*

Electron Detectors installed at RHIC

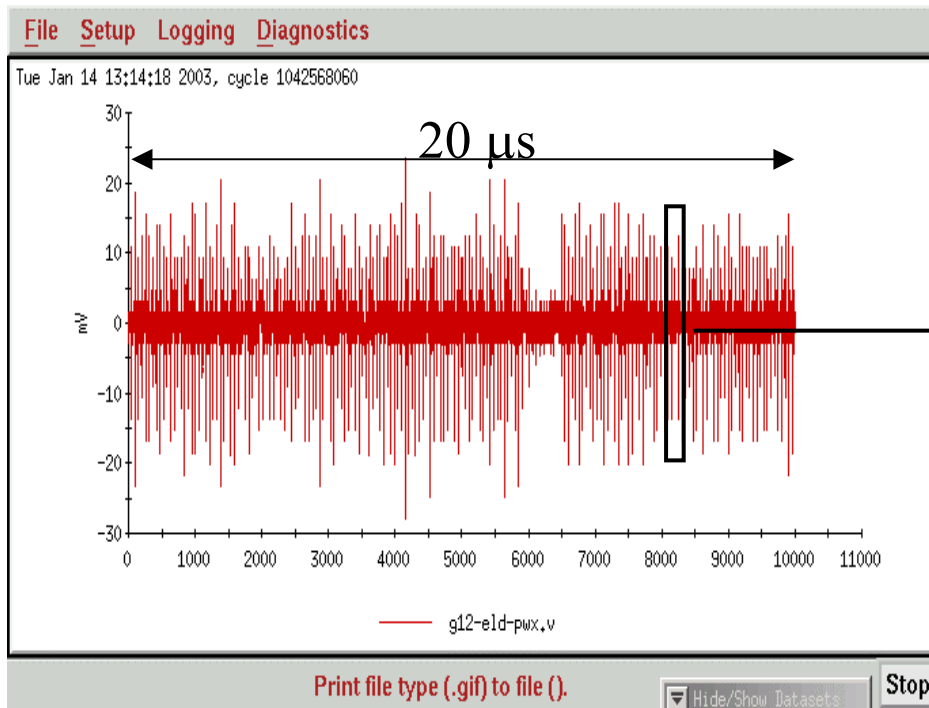
- 11 BNL ED
- 1 Micro Channel Plate
- 4 SNS ED
- 1 ANL ED



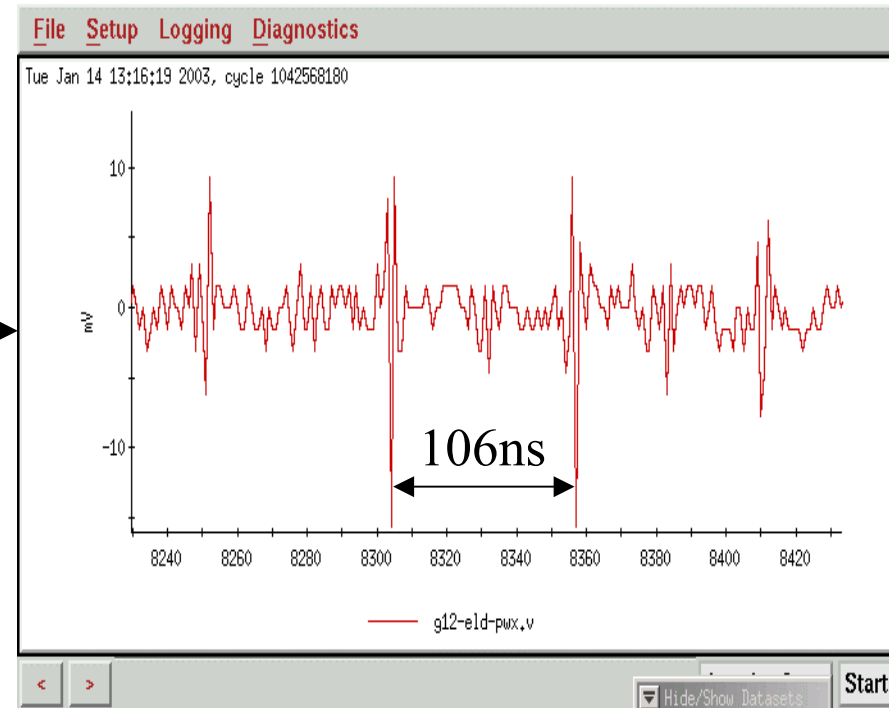
■ ED, H&V
 □ ED, V
 --- Solenoid
 ○ Pin Diodes
 ■ MCP
 ■ RGA
 ■ ANL ED
 ■ SNS ED

Some cases

- NO ELECTRON CLOUD SIGNAL HAS BEEN DETECTED SO FAR
- The ED acts as a button pick-up that sees the **image current** of the bunch. The signal is inversely proportional to the bunch length.

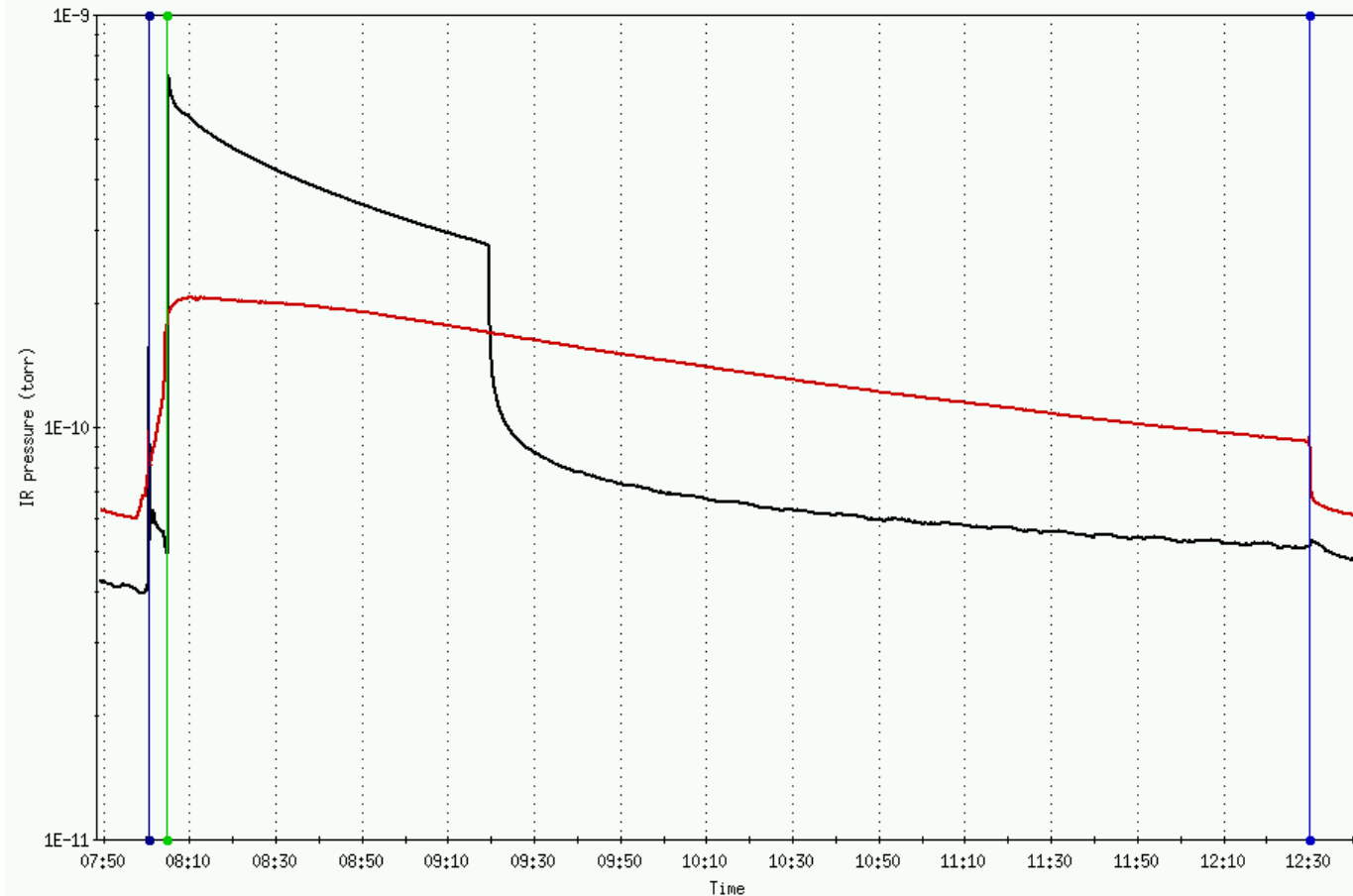


Signal produced by 1.5 Au-trains of 110 bunches.



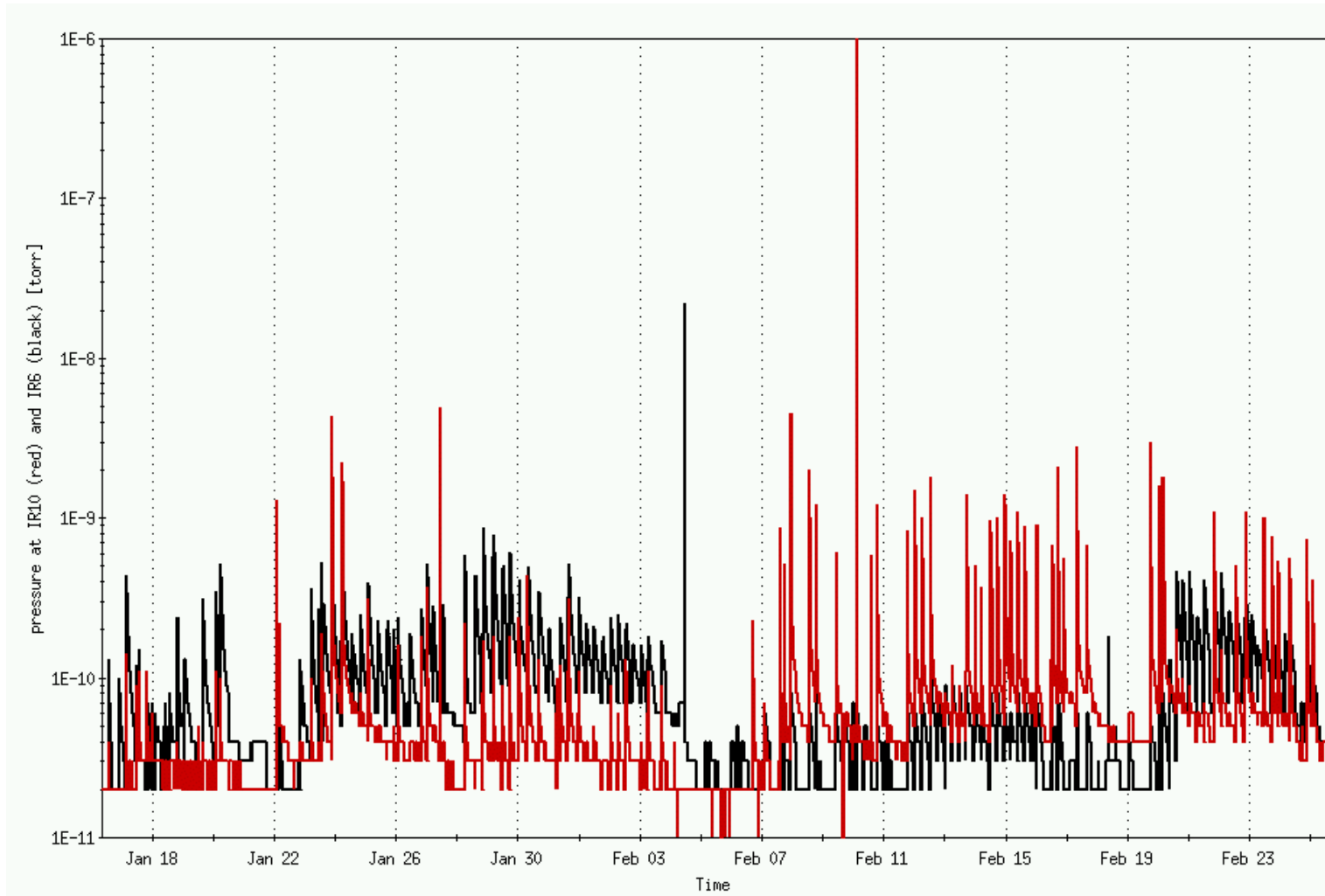
Zoom of 4 bunches

during a store in STAR and PHOBOS



Evolution in store is very different (?). Causes unacceptable backgrounds in PHOBOS and high trigger rates in STAR

IR pressure Jan 10 - Feb 25



Base pressure keeps increasing if we run just at the vacuum limit!

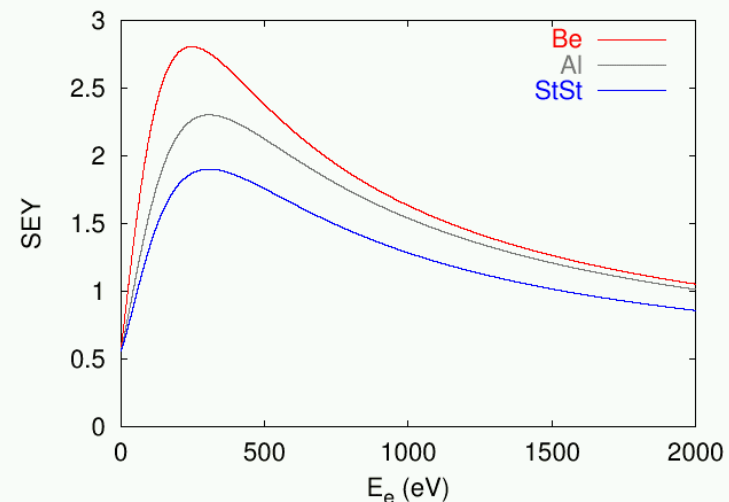
Secondary Electron Yields

At RHIC we have pretty much all (bad) materials present:

Electron fluxes to the beam pipe wall for the different IR materials for nominal RHIC conditions: $N_b = 10^9 Au^{79+}$ and 55 bunches.

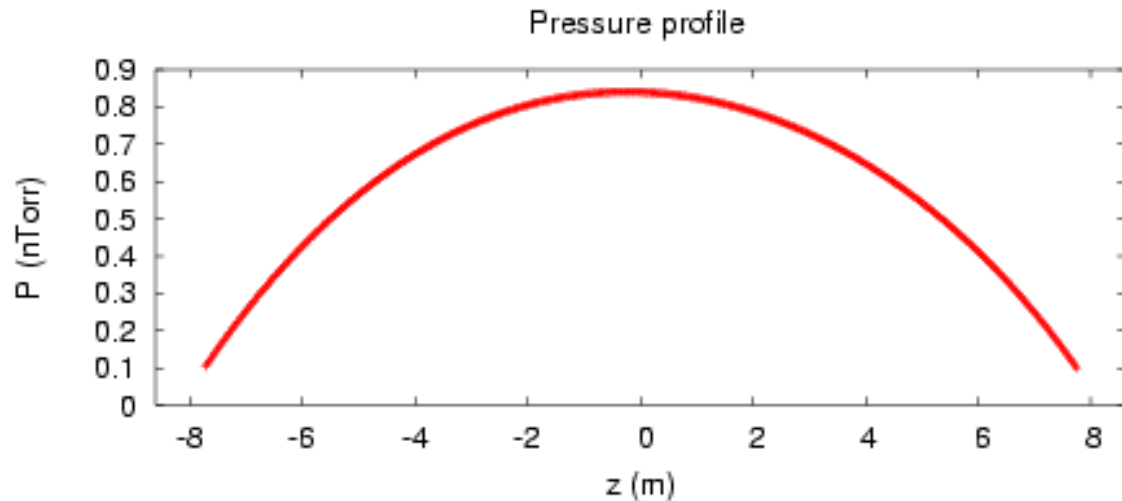
material	SEY	E_{max} (eV)	I (mA/m)
St St	1.9	310	4
Al	2.3	300	13
Be	2.8	250	30

SEY for the different IR materials

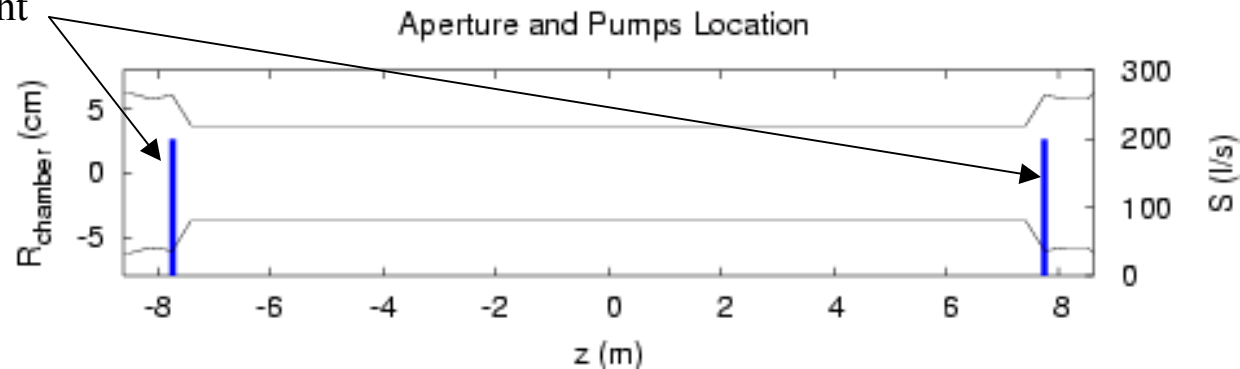


In addition we have a few sections with NEG coating available.

pressure evolution in in TD



Point of measurement

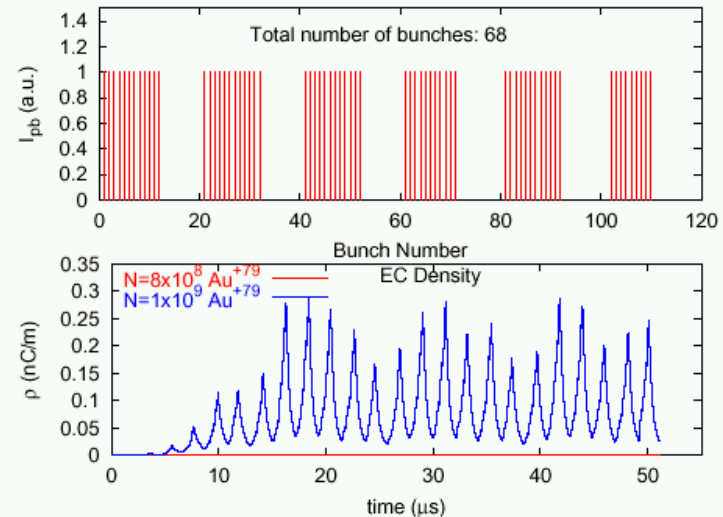
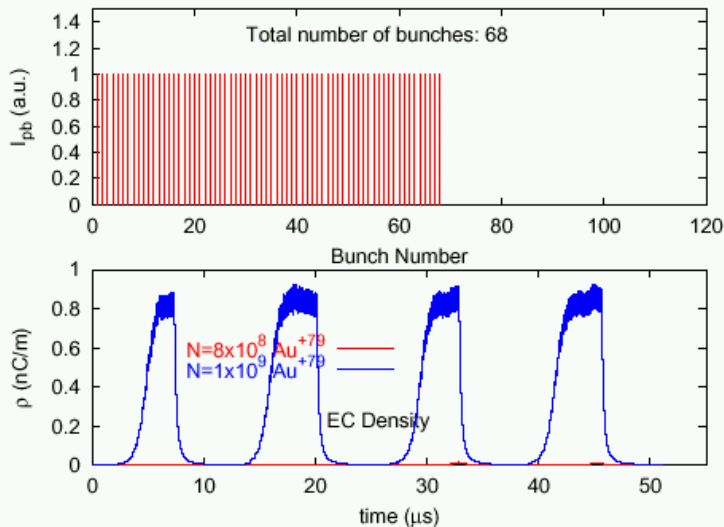


Study going on right now:
Try to match predicted background and accidental
coincidence rates with measured rates from experiments.

Predicted electron density

Continuous 212 ns spacing

Trains of 212 ns spaced bunches



Simulation predicts significant changes of electron cloud evolution as a function of the fill pattern (at constant total beam currents). In RHIC we can load the machine with a variety of patterns with two spacings (106 ns or 212 ns) and a total between 1 and 110 bunches

Luminosity Monitor Testing/Commissioning

Luminosity Monitors (Ion Chambers & CdTe) should/could be shipped to BNL to be tested in RHIC as luminosity monitors:

- signal/noise

- reliability

- accuracy

- stability (varying conditions etc.)


We have one IR (12 o'clock) prepared and ready for equipment testing next pp run in FY05

Propose: one physicist from BNL at CERN for luminosity monitor commissioning at LHC

Beam Commissioning: SPS test beam

WHAT	WHEN	CERN LIAISON	
	2004		
TI8			
Materials testing	Sept 04	R. Schmidt, V. Kain	← BNL
Optics matching	Sept 04	J. Uythoven	
SPS			
Phase Lock Loop	June/Sept 04	R. Jones	
Collimators (& TI8)	Sept 04	R. Assmann, R. Schmidt	← BNL
Ecloud & vacuum diagnostics & studies	Sept 04	M. Jimenez, F. Zimmerman	← BNL
Impedance & high current tests	?? Sept 04 ??	F. Ruggiero, E. Shapashnikova	
Long range beam-beam wire compensators	Summer 04	J.P. Koutchouk	
	2005		
	2006		
Sector test with beam	May 06	M. Lamont	
	2007		

budget “requests”



Summary

- RHIC is currently limited in achievable luminosity by e-cloud/vacuum effects.
- RHIC is the perfect test-bed with all materials: StSt, Al, Be, NEG
- There is some 'horsepower' working on e-cloud already
- The next most prominent issue at RHIC are experimental backgrounds and collimation.
- RHIC offers loss data with protons and heavy ions (some already available)
- Multiple collimator control schemes can be tested
- BNL could participate in luminosity monitor testing/commissioning
- Collimator and e-cloud experts will be ready (and trained) to participate in LHC commissioning.